Improving Surveillance for Ventilator-Associated Events in Adults

Centers for Disease Control and Prevention (CDC)

Overview and Proposed New Definition Algorithm

What is the National Healthcare Safety Network (NHSN)?

- NHSN is the CDC's healthcare-associated infections (HAI) surveillance system (www.cdc.gov/nhsn). NHSN uses standard methodology and definitions to collect data from U.S. healthcare facilities. More than 12,000 healthcare facilities in all 50 states now participate in NHSN. Most participating facilities report data on device-associated HAIs, including ventilator-associated pneumonia (VAP). Many states require hospitals to report HAIs using NHSN.

How is VAP surveillance currently conducted in NHSN?

- NHSN's current pneumonia (PNEU) definitions were last updated in 2002, and were designed to be used for surveillance of all healthcare-associated pneumonia events, including (but not limited to) VAP.
- Three components make up the current PNEU definitions: an "X-Ray" component (required), a "Signs and Symptoms" component (required), and a "Laboratory" component (optional).
- VAP is specifically defined as a PNEU event that occurs at the time a ventilator is in place, or within 48 hours after a ventilator has been in place. There is currently no required duration that the ventilator must be/have been in place for a PNEU to qualify as a VAP.

Why is the CDC changing the way VAP surveillance is done in NHSN?

- The current PNEU definitions are useful for internal quality improvement purposes, but are limited by their subjectivity and complexity. It is necessary to have objective, reliable surveillance definitions for use in public reporting and inter-facility comparisons of event rates and federal pay-for-reporting and -performance programs.

What is the CDC's process for improving NHSN VAP surveillance?

- The CDC's Division of Healthcare Quality Promotion (DHQP) is collaborating with the CDC Prevention Epicenters (http://www.cdc.gov/hai/epicenters), the Critical Care Societies Collaborative (CCSC, http://ccsconline.org), other professional societies and subject matter experts, and federal partners.
- DHQP initiated a collaboration with the CCSC in September 2011, and convened a **VAP Surveillance Definition Working Group**, consisting of representatives from several organizations with expertise in critical care, infectious diseases, healthcare epidemiology and surveillance, and infection control.

Organization	*Representative(s)*
American Association of Critical-Care Nurses	Ms. Suzanne Burns and Ms. Beth Hammer
American Association for Respiratory Care	Dr. Dean Hess
American College of Chest Physicians	Drs. Robert Balk and David Gutterman
American Thoracic Society	Drs. Nicholas Hill and Mitchell Levy
Association of Professionals in Infection Control and Epidemiology	Ms. Linda Greene
Council of State and Territorial Epidemiologists	Ms. Carole VanAntwerpen
HICPAC Surveillance Working Group	Dr. Daniel Diekema
Infectious Diseases Society of America	Dr. Edward Septimus
Society for Healthcare Epidemiology of America	Dr. Michael Klompas
Society of Critical Care Medicine	Drs. Clifford Deutschman, Marin Kollef, and Pamela Lipsett

- The Working Group recognized that there is currently no gold standard, valid, reliable definition for VAP. Even the most widely-used VAP definitions are neither sensitive nor specific for VAP. Therefore, the Working Group decided to pursue a different approach—development of a surveillance definition algorithm for detection of ventilator-associated events (VAEs). This algorithm will detect a broad range of conditions or complications occurring in mechanically-ventilated adult patients.
- Because the reliability of HAI definitions has become particularly important in recent years, the Working Group focused on definition criteria that use objective, clinical data that are expected to be readily available across the spectrum of mechanically-ventilated patients, intensive care units and facilities—in other words, criteria that are less likely to be influenced by variability in resources, subjectivity, and clinical practices—and that are potentially amenable to electronic data capture.

What progress has the Working Group made?

- The Working Group has proposed a new surveillance definition algorithm to detect VAEs in adult patients. It is not designed for use in the clinical care of patients. The Working Group anticipates that the new definition algorithm will continue to be refined, based on the results of field experience and additional research. The definition algorithm refinement process is, and will continue to be iterative, and will require the ongoing engagement of the critical care, infection prevention, infectious diseases and healthcare epidemiology communities.

What is the new, proposed NHSN surveillance definition algorithm?

- The definition algorithm (presented on page 3) is only for use with the following patients:
  - Patients ≥ 18 years of age;
  - Patients who have been intubated and mechanically ventilated for at least 3 calendar days; and
  - Patients in acute and long-term acute care hospitals and inpatient rehabilitation facilities.
- NOTE: Patients receiving rescue mechanical ventilation therapies (e.g., high-frequency ventilation, extracorporeal membrane oxygenation, or mechanical ventilation in the prone position) are excluded from surveillance using the new, proposed definition algorithm.

How is the new surveillance definition algorithm different from the current PNEU definitions?

- The new algorithm: 1) will detect ventilator-associated conditions and complications, including (but not necessarily limited to) VAP; 2) requires a minimum period of time on the ventilator; 3) focuses on readily-available, objective clinical data; and 4) does not include chest radiograph findings.

Why are chest radiographs not included in the new surveillance definition algorithm?

- Evidence suggests that chest radiograph findings do not accurately identify patients with VAP. Furthermore, the variability in radiograph ordering practices, technique, interpretation, and reporting make chest radiograph findings less well-suited for inclusion in an objective, reliable surveillance definition algorithm to be used for public reporting and inter-facility comparisons of event rates and pay-for-reporting and -performance programs.

How will I find cases using the new algorithm?

- CDC is working on operational guidance to help healthcare facility staff implement the new algorithm for electronic or manual event detection, once it is ready for deployment in NHSN. A possible method to make VAE surveillance more efficient is to organize data elements in a flow sheet at the patient's bedside. In the example below, the shaded area highlights the period during which a possible VAP event is detected.

VentDay	*PEEPmin*	*FiO_2min*	*Tmin*	*Tmax*	*WBCmin*	*WBCmax*	*Antimicrobials*	*Spec*	*Polys*	*Epis*	*Organism*
1	10	60	37.9	38.1	12.1	14.2	None	--	--	--	--
2	5	40	37.1	37.5	11.8	11.8	None	--	--	--	--
3	5	40	36.9	37.6	12.1	12.1	None	ETA	≥25/lpf	<1/lpf	*S. aureus*
4	8	60	38.1	39.2	14.5	16.8	PIPTAZ, VANC	--	--	--	--
5	8	50	38.4	38.9	12.6	15.9	PIPTAZ, VANC	--	--	--	--
6	7	40	36.5	37.8	11.1	13.6	PIPTAZ, VANC	--	--	--	--
7	5	40	36.2	37.0	11.5	13.0	PIPTAZ, VANC	--	--	--	--
8	5	40	36.7	37.3	8.3	8.3	PIPTAZ, VANC	ETA	<1/lpf	.0-25/lpf	Oral flora

PEEPmin=minimum positive end-expiratory pressure. FiO_2min=minimum fraction of inspired oxygen. Tmin, Tmax=minimum temperature, maximum temperature. ETA=endotracheal aspirate. PIPTAZ=piperacillin/tazobactam. VANC=vancomycin. Spec=specimen type. Polys=polymorphonuclear leukocytes. Epis=epithelial cells. lpf=low power field.

What are the next steps, and when will the new algorithm be implemented in NHSN?

- The Working Group has identified key research agenda items, which include:
  - Evaluation of candidate variables to use in achieving additional unit-level risk adjustment or stratification of ventilator-associated condition and complication rates.
    - Rates (events per 1000 ventilator days) will be stratified according to the current NHSN standard—by intensive care unit type, and for selected unit types, by bed size and academic affiliation.
  - Evaluation of denominator (ventilator day) data collection strategies.
- The goal for implementation in NHSN is January 2013.

For additional information:

- Please contact the NHSN Helpdesk at nhsn@cdc.gov.

Surveillance Definitions for Ventilator-Associated Events:

- For use in acute and long-term acute care hospitals and inpatient rehabilitation facilities.
- For use in patients ≥ 18 years of age who are on mechanical ventilation for ≥3 calendar days.
- NOTE: patients on rescue mechanical ventilation (e.g., HFV, ECMO, mechanical ventilation in prone position) are EXCLUDED.

Patient has a **baseline period of stability or improvement on the ventilator**, defined by **≥ 2 calendar days of stable or decreasing FiO_2 or PEEP**. Baseline FiO_2 and PEEP are defined by the minimum daily FiO_2 or PEEP measurement during the period of stability or improvement.

After a period of stability or improvement on the ventilator, the patient has at least one of the following indicators of worsening oxygenation:
1) Minimum daily FiO_2 values increase ≥ 0.20 (20 points) over baseline and remain at or above that increased level for **≥ 2** calendar days.
2) Minimum daily PEEP values increase ≥ 3 cmH_2O over baseline and remain at or above that increased level for **≥ 2** calendar days.

Ventilator-Associated Condition (VAC) → **Public Reporting Definition**

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets <u>both</u> of the following criteria:

1) Temperature > 38 °C or < 36°C, OR white blood cell count ≥ 12,000 cells/mm^3 or ≤ 4,000 cells/mm^3.

AND

2) A new antimicrobial agent(s) is started, and is continued for ≥ 4 calendar days.

Infection-related Ventilator-Associated Complication (IVAC) → **Public Reporting Definition**

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, ONE of the following criteria is met:

1) Purulent respiratory secretions (from one or more specimen collections)
   - Defined as secretions from the lungs, bronchi, or trachea that contain ≥25 neutrophils and ≤10 squamous epithelial cells per low power field [lpf, x100].
   - If the laboratory reports semi-quantitative results, those results must be equivalent to the above quantitative thresholds.

2) Positive culture (qualitative, semi-quantitative or quantitative) of sputum, endotracheal aspirate, bronchoalveolar lavage, lung tissue, or protected specimen brushing

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, ONE of the following criteria is met:

1) Purulent respiratory secretions (from one or more specimen collections—and defined as for possible VAP)

   AND one of the following:
   - Positive culture of endotracheal aspirate, ≥ 10^5 CFU/ml or equivalent semi-quantitative result
   - Positive culture of bronchoalveolar lavage, ≥ 10^4 CFU/ml or equivalent semi-quantitative result
   - Positive culture of lung tissue, ≥ 10^4 CFU/ml or equivalent semi-quantitative result
   - Positive culture of protected specimen brush, ≥ 10^3 CFU/ml or equivalent semi-quantitative result

2) One of the following (without requirement for purulent respiratory secretions):
   - Positive pleural fluid culture (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube)
   - Positive lung histopathology
   - Positive diagnostic test for *Legionella* spp.
   - Positive diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus

Possible Ventilator-Associated Pneumonia ← **Internal Quality Improvement** → **Probable Ventilator-Associated Pneumonia**